Information-Request/Submittal/Release		Number	S	038-0014
Number of attached pages	17	New ☒		
Project	MACS	Revision ☐		
Originator	T. D. Pike	If revision, provide the following:		
Date	14 May 2004	Previous Submittal		
Database Reference	See Below	ECR/ECN		

Scope

Specification for the MACS Monochromatic Beam Transport Shield elements

Purpose

To provide specifications for the MACS Monochromatic Beam Transport Shield elements to allow the corresponding sub-projects to proceed in parallel with general development of MACS.

(Document file: MBT Shield Spec. 1b5a .doc)

Description

Text and images that specify the requirements for the Monochromatic Beam Transport Shield elements and that define the interface with the rest of MACS. A prior solid body submission to the C-100 database fully describes these bodies.

Data Base References: Floor Shield, 038-0024; North Top Shield, 038-0025; South Top Shield, 038-0026.

Filing

When filed as a submittal, this form and the information attached to it transforms into a released document when it is signed by all parties named in it. The form with attachments is kept on file in the office of the NIST chief engineer. When attachments are electronic in nature (such as electronic CAD data) that information and its hierarchical position in the project design tree shall be identified in or under this submittal. Information Requests, Submittals and Releases are numbered separately, yet sequentially.

Change Process

Anyone can propose a change to documentation that is released under this form. To such end an Engineering Change Request (ECR) is filed. A priori, the change board is composed of the individuals that signed the submittal against which the ECR is drawn. Approval of the ECR turns it into an Engineering Change Notice (ECN), which gives authority to prepare a new submittal. The new submittal covers at least the fully executed ECN. Approval of the new submittal signifies close-out (full implementation) of the ECN.

Endorsements (list composition is part of release and determines Change Board for ECR/N's)

	Submitted		Reviewed		
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2	P. K. Hundertmark		2		038-0014
3	C. L. Broholm		3		
4			4		
5			5		

General Specification for Development of the Monochromatic Beam Transport Shields

for the

Multi-Axis Crystal Spectrometer (MACS)

National Institute of Standards and Technology

Center for Neutron Research

Specification NG-0 –3.3 MBT Shields

Revision 1

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1.0 Project Overview

This specification is for the construction of the shielding that serves to support and surround the Monochromatic Beam Transport (MBT) system described below.

This instrument is a portion of a neutron spectrometer, referred to as MACS. The particular elements described here are devices for transporting the monochromatic neutron beam emanating from the monochromator cask to the sample. The Monochromatic Beam Transport (MBT) system contains guide mirrors arranged to direct the monochromated beam toward the sample that is under examination in this spectrometer. The channel that contains the mirrors allows the vertical mirrors to move independently, rotating about vertical axes located near the exit end. The approximately horizontal mirrors are fixed above and below the vertical mirrors. The mirror channel is primarily contained within a low-pressure helium filled drum with the exit end of the channel forming a protrusion at the exit end of the channel. The drum is a right circular cylinder with domed ends, which rotates about its vertical axis.

The drum assembly is held in a cylindrical saddle formed by two segments of a vertical wall. The mirror channel entrance and exits are revealed as well as a portion of the surface of the drum between the two wall segments. To complete the enclosure of the drum, a lower pillar supports the drum, while a cap fills the volume above the top of the drum to the full height of the walls. Thus, the combination of the drum and wall create a barrier that is pierced only by the mirror guide.

Because this portion of the MACS instrument may be exposed to a very strong magnetic field from a superconducting magnet centered at the sample position, all materials must be non-magnetic. Any exceptions to the non-magnetic requirement will be considered on a case-by-case basis.

2. Overall Specifications

The MACS Monochromatic Beam Transport (MBT) shields provide necessary and sufficient neutron absorption to prevent unwanted radiation from the incident beam escaping from the instrument. The performance of the shields is critical from both the instrument requirements and from the safety requirements.

2.1 Bounding box dimensions

The MBT shields are comprised of three primary components: North shield, South shield, and Base shield. The MBT shielding shall occupy the overall bounding box described in figures (3), (4), (5) and (6) as well as the solid body in the accompanying **IGES files**. Clearance from the MBT to the bounding box shall be at least 10 mm in directions in the horizontal plane and above the MBT. See Figure 3.

2.2 Materials and overall shielding requirements

All volumes of the MBT shields not required for mechanical clearance shall be filled with shielding material. Typical materials employed are listed below:

1. Non-magnetic Stainless Steel

2. Bulk shielding material:
    a. 55% ± 5% (volume fraction) Non-magnetic Stainless Steel shot in 45% ± 5% wax held in a closed Non-magnetic Stainless Steel containment vessel.

All materials used in the fabrication of the MBT shields shall be non-magnetic. Specifically the relative permeability, μ_r, at low fields and room temperature shall not exceed 1.02. This condition is satisfied for annealed Austenitic grades (300 series) of stainless steel. Since the magnetic permeability of stainless steel increases with cold work, formed and welded sections may require re-annealing.

The completed vessels shall be tested with a magnetic field strength tester to verify compliance. Particularly the west face elements must comply. The stainless steel shot shall either be certified to have magnetic permeability below 1.02, or shall be re-annealed.

Some information about the magnetic permeability of stainless steel can be found at: http://www.matweb.com

2.3 Shielding & Construction Considerations

Three elements compose the MBT Shield volume:

1. MBT North Shield
2. MBT South Shield
3. MBT Platform Shield

The MBT North, South and Platform shields shall be fabricated from austenitic stainless steel and shall be filled with austenitic stainless steel shot and wax as detailed above.

The construction of the external surfaces of the MBT North, South and Platform shields shall be generally a vertical projection of the plan, the most notable exception being the step which projects up from the top of the Platform shield to mate with the recesses in the North and South shields. See Figure 4, view A-A.

Wall thickness of the shields shall nominally be 10 mm. The three exceptions to this are the West center face, and the two (east and west) top center faces of the Platform Shield, which shall be 25 mm thick.

Liberally sized openings for introducing the wax & shot to the shield shells are shown in the accompanying drawings. Dimensions of these openings are at the vendors discretion. Locations of baffles to separate internal segments while preventing overflow to further facilitate shield filling are at the vendors discretion as well. To resist hydrostatic forces during filling, the vendor may choose to add internal webbing as well.

2.4 Attachment to MACS

The MBT Shield assembly shall be fully self-supporting on the C-100 floor, with the North and South Shields supported fully by the Platform Shield. Horizontal mounting pads shall provide for leveling to the nominally flat floor. Refer to Figures (9) and (10) for details. Figure 11 shows the relationship between the MBT shields and the adjacent sample support and analyzer elements.

The nominal distance from the floor surface to beam height shall be 1066.8 mm, refer to figure (2) for other dimensions. Threaded receivers for lifting eyes shall facilitate the installation and removal of the MBT Shields and its components using an overhead crane. Lifting eye locations shall be designed around the center of gravity of each shield. The receivers shall be threaded ¾-10 UNC-2B with a minimum full thread depth of 1-1/2 inches.

2.5 Assembly attachment and alignment

The MBT is positioned in MACS by virtue of three defining dimensions. First, the axis of the MBT Drum is placed such that the center of the drum is 775 mm from the beamline axis. Second, the axis of the Drum is located on a line perpendicular to the beamline at the 6200 datum of the beam. Third, the nominal distance from the floor to the beam axis is 1066.8 mm. When installed the relative alignment of the axis of the tapered bore within the MBT drum shall coincide within ± 1.0 mm of the above described axes.

2.6 General dimensions

Assembled	
H x W x D	2001 × 3060 × 885 mm
Mass	13300 Kg
North Shield	
H x W x D	1658 × 1208.5 × 585 mm
Mass	4300 Kg
South Shield	
H x W x D	1658 × 1480 × 735 mm
Mass	5400 Kg
Platform Shield	
H x W x D	566 × 3060 × 885 mm
Mass	3600 Kg
Drum Assembly (reference)	
H × Diameter	700 × 960 mm
Mass	500 Kg

3. Additional Tolerances

An overall tolerance of ±5 mm shall be applicable to the above General Dimensions of the shields. This tolerance is assumed to apply uniformly to the Associated CAD File Bodies for the shields. Additional tolerances apply to the following surfaces in the assembled condition:

3.1 Perpendicularity:

3.1.1 The concave circular surfaces on both the north and south shields shall be perpendicular to the MBT Drum Assembly mounting surface to within ± 5mm.

3.1.2 The outer vertical surfaces sharing a vertical edge with the concave circular surfaces on both the north and south shields shall be perpendicular to the horizontal MBT Drum Assembly mounting surface within ± 5mm.

3.2 Coplanarity:

3.2.1 The outer vertical surfaces sharing a vertical edge with the concave circular surfaces on both the north and south shields shall be coplanar with each other to ± 5mm.

3.3 Parallelism:

3.3.1 The horizontal MBT Drum Assembly mounting surface shall be parallel to the bottom horizontal surface of the MBT Shield Platform to within ± 5mm.

To achieve the above tolerances, permanently attached local shims may be used provided that any gaps produced between assembly elements are less than 8 mm.

4. Additional Specifications

Additional specifications will be provided by NIST for the following:

- Interfaces to other MACS elements

The contractor for the MBT Shield Assembly shall develop specifications for the following:

- Stainless steel shot & wax filling procedures
- Paint & finish procedures
- Inspection procedures

Project Engineering Contact

Mechanical & Systems Timothy Pike 301.975.8373 tpike@nist.gov

Element	ΔX	ΔXi	ΣΔXi	x	y Radius	2y Diameter	2Y Clearance Diameter
Theoretical Beam Convergence Point				**-1600**	0		
Cold Source Face				0	44.7	89	101
Beam Hol 184 ref				1654	90.9	182	205
Face of Bio Shield @	781			2435	112.7	225	254
Forward Edge of Bio Shield				2600	117.3	235	264
Shutter In				**2650**	118.7	237	267
Anti-Streaming Dome (In)		50		**2700**	120.1	240	270
Anti-Streaming Dome (Out)		50		**3400**	139.7	279	314
Shutter Out		700	800	**3450**	141.1	282	317
Cryo Filter Exchanger		CFX	450	**3475**	141.8	284	319
Sapphire	43	150		**3510**	142.7	285.9	322
	7			3660	146.9	294.3	
Beryllium		100		**3675**	147.3	294.7	332
	7			3775	150.1	300.3	
Pyrolytic Graphite		100		**3790**	150.6	300.7	338
	43			3890	153.3	306.3	
				3925	154.3	309	347
	10						
Choke Entrance	120			**3935**	154.6	309.2	348
Exit				4055	158.0	315.9	355
	39						
Cask In				**4094**	159.0	318.1	358
	56						
In-line Collimator Exchanger		ICX	355	**4150**	160.6	321	361
		140		4290	164.5	329	370
	5			**4295**	164.7	329	371
		210		4505	170.5	341	384
	45						
Variable Beam Aperture		VBA	205	**4550**	171.8	344	387
		100		4650	174.6	349	393
	5			**4655**	174.7	349	393
		100		4755	177.5	355	399
Monochromator		DFM					
Leading Edge	38			**4793**	178.6	357	402
Axis 35°	300			**5093**	187.0	374	421
Axis 90°		Total Travel		**6200**	217.9	436	490
Axis 105.4°		1757		**6413.5**	223.8	448	504
Axis 130°				**6850**	236.0	472	531
Trailing Edge				**7150**	244.4	489	550
	300						
Cask Out	2150		3356	**7450**	252.8	506	569
Beam Dump				**9600**	312.8	626	704

Table 1 1.600-Degree Divergence Beam Equation **Rev. 6**

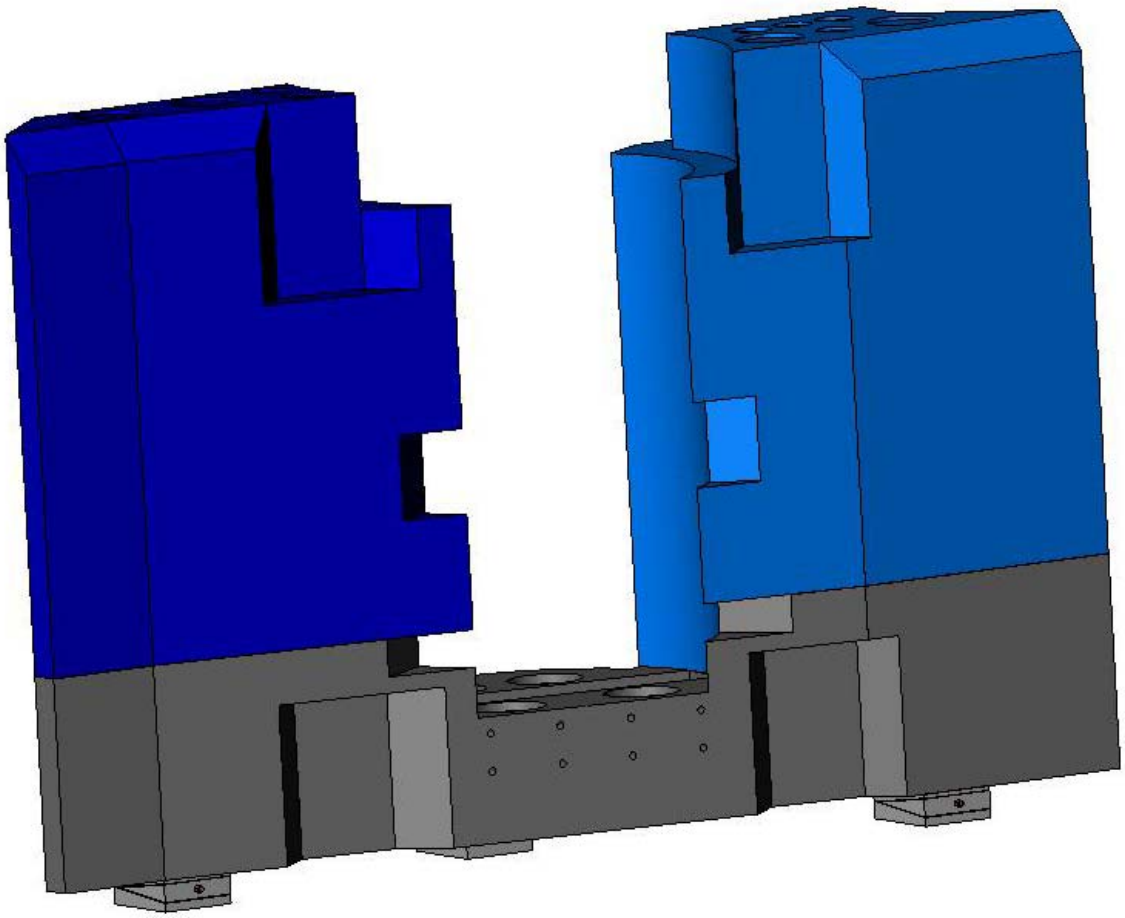

Figure 1 Trimetric View of MBT Shields

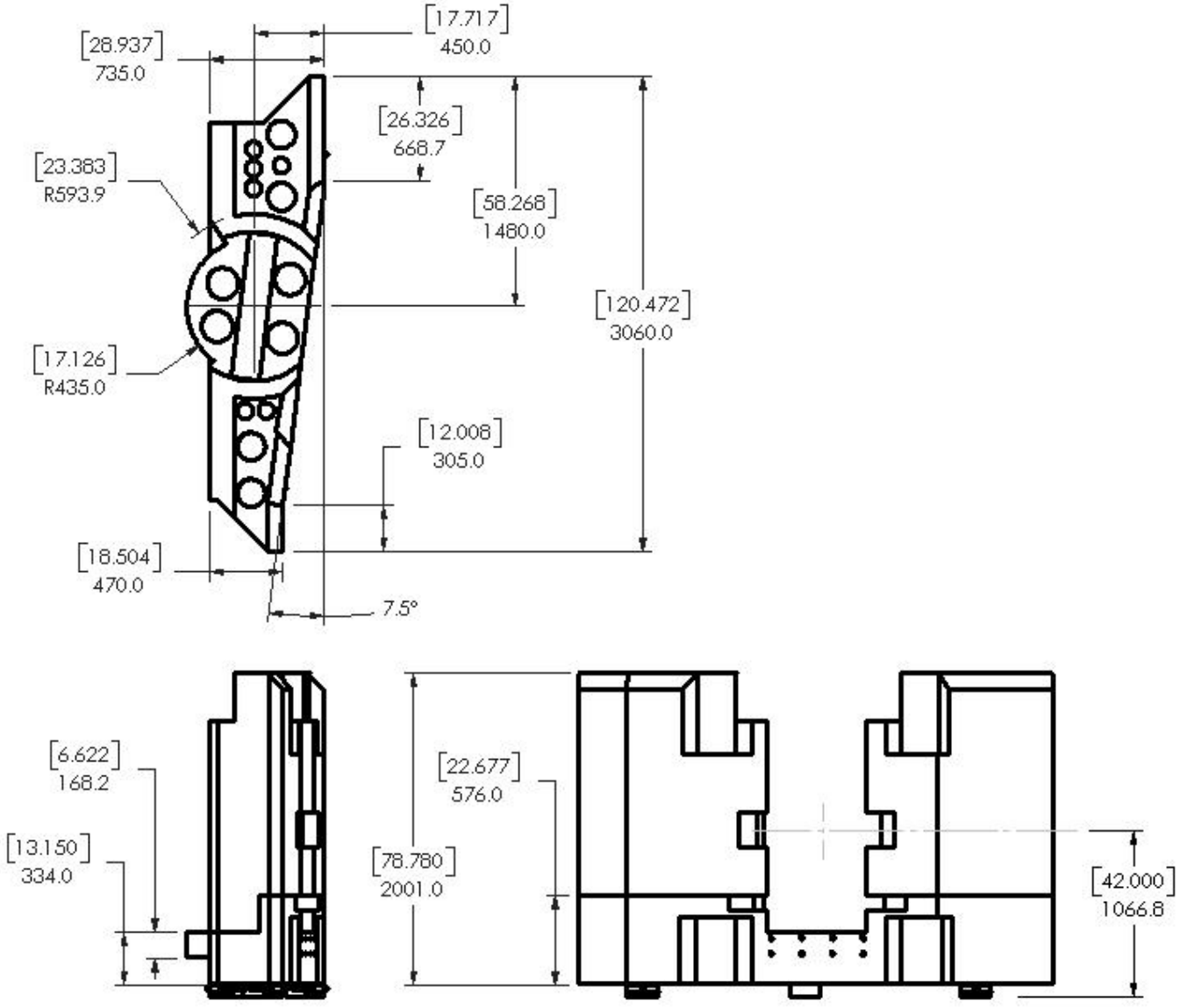

Figure 2 Views of the MBT Shields with Overall Dimensions

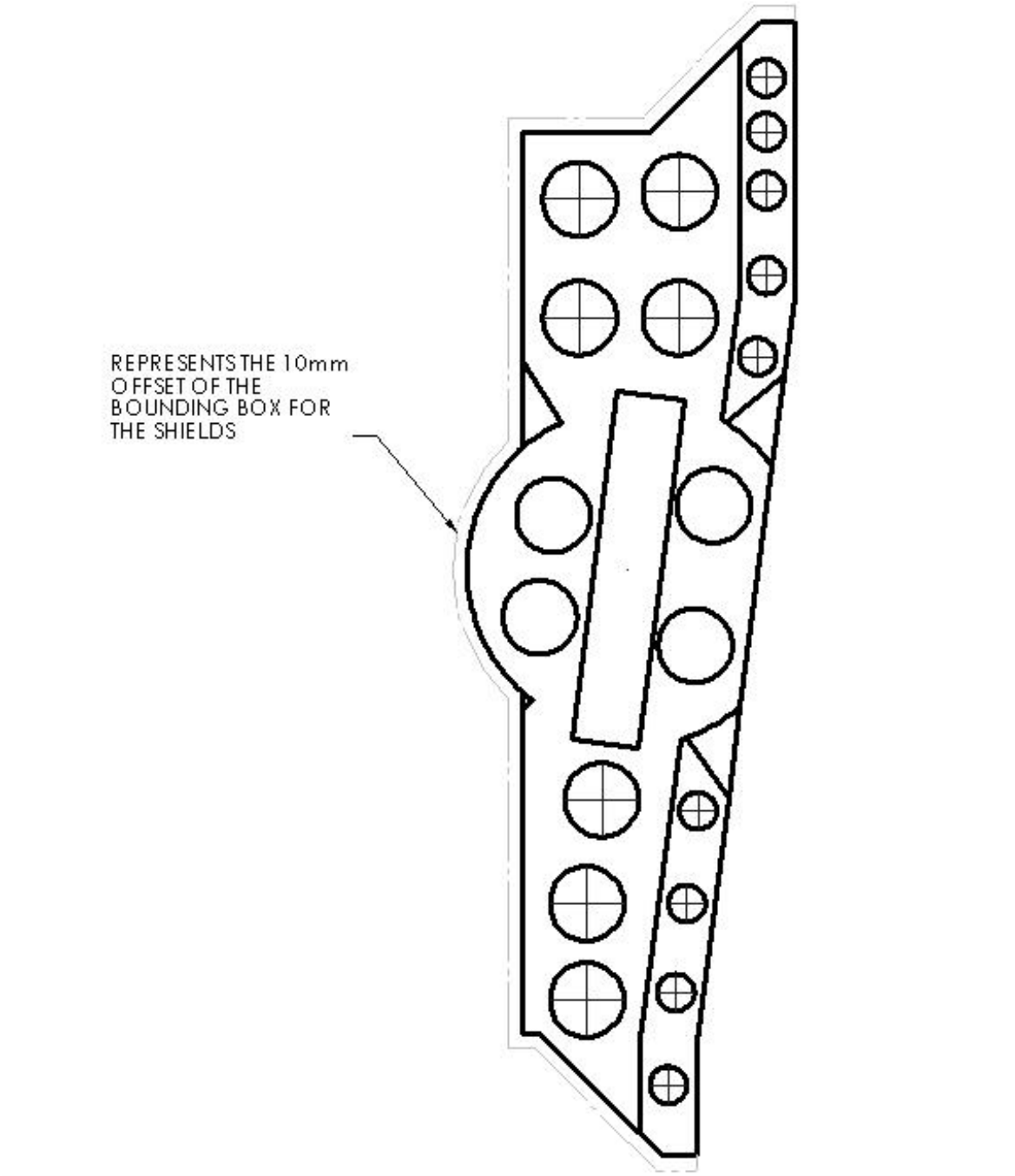

Figure 3 MBT Base Shield Showing Bounding Offset

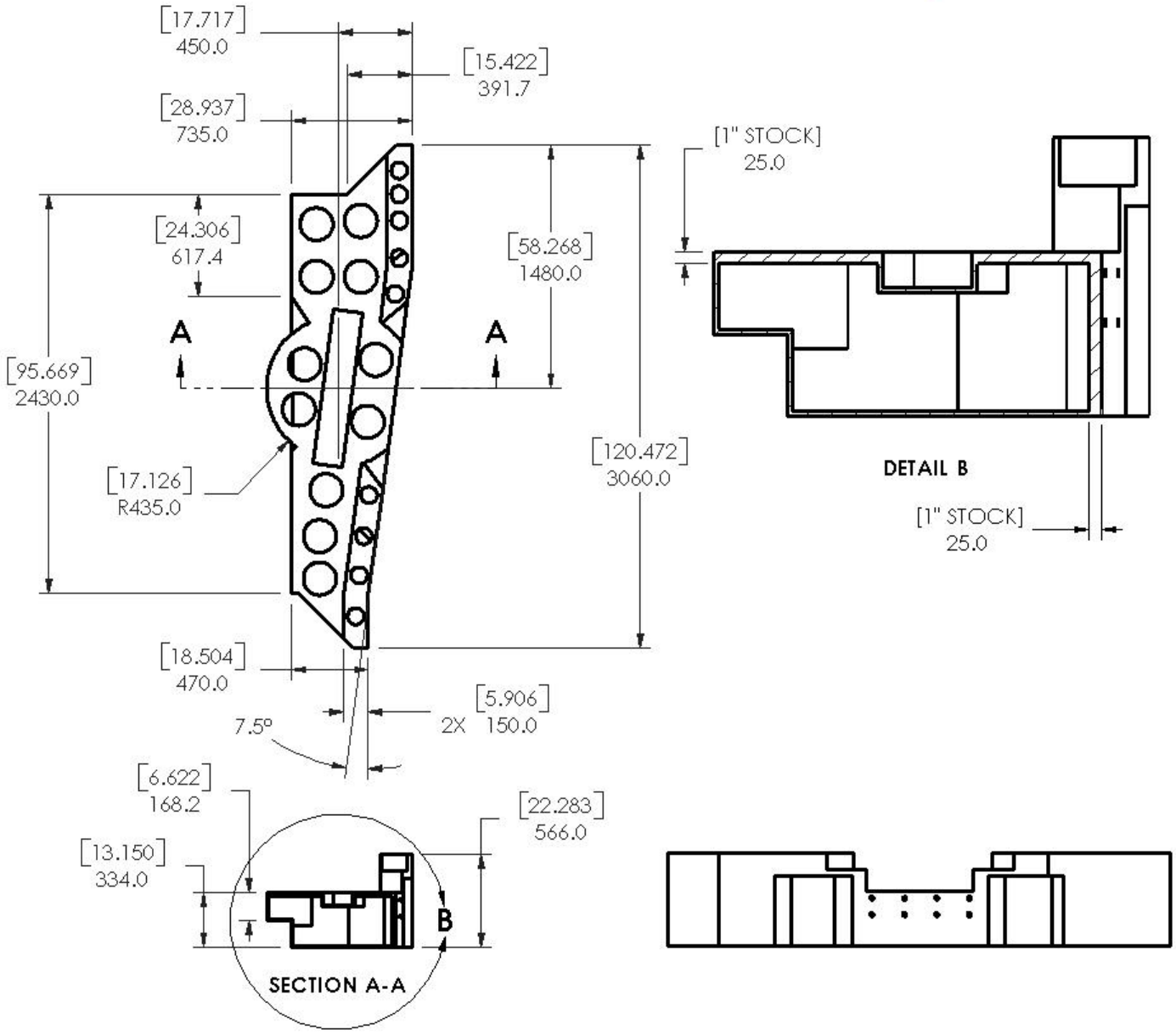

Figure 4 MBT Base Shield Dimensioned

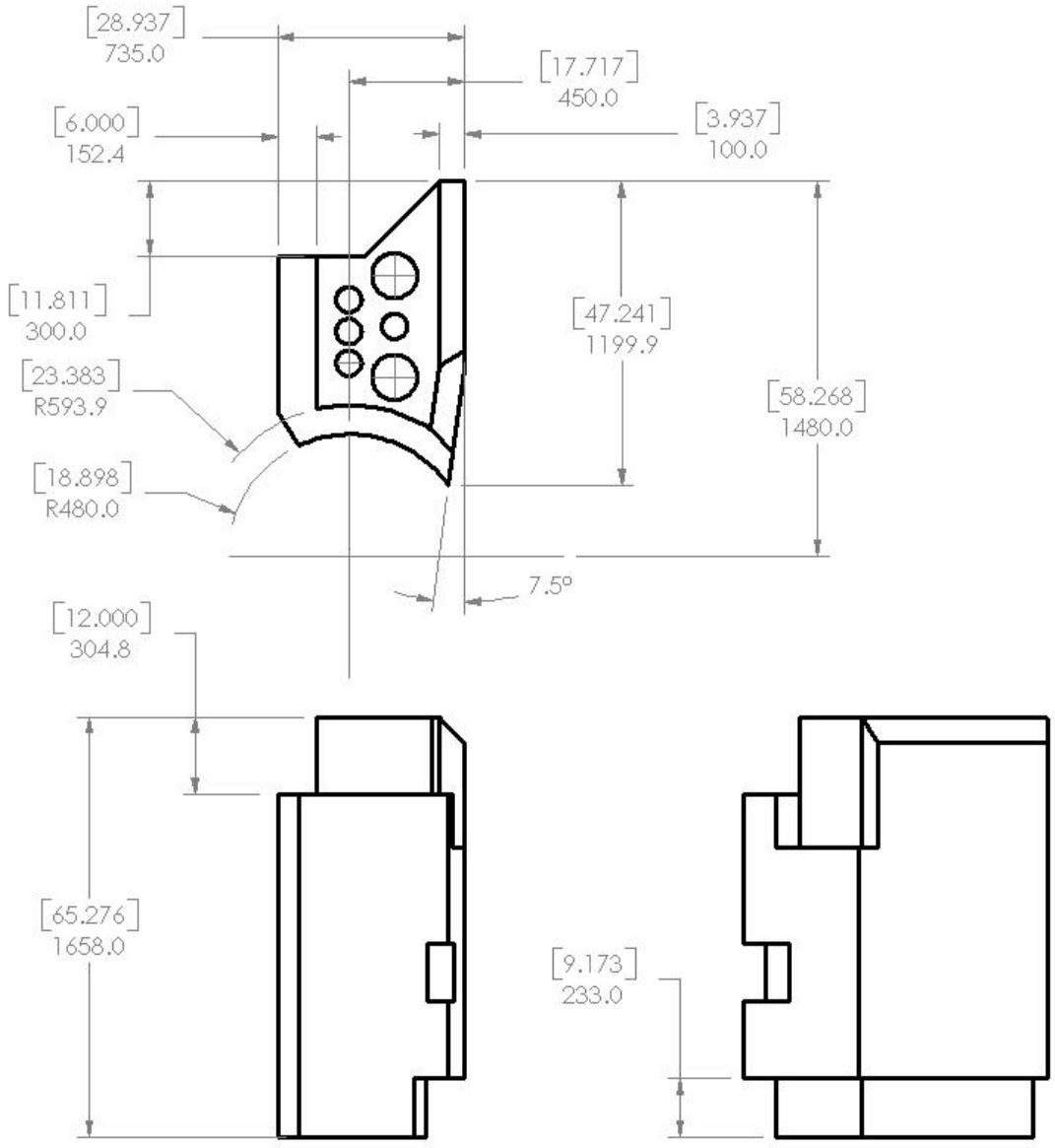

Figure 5 MBT South Shield

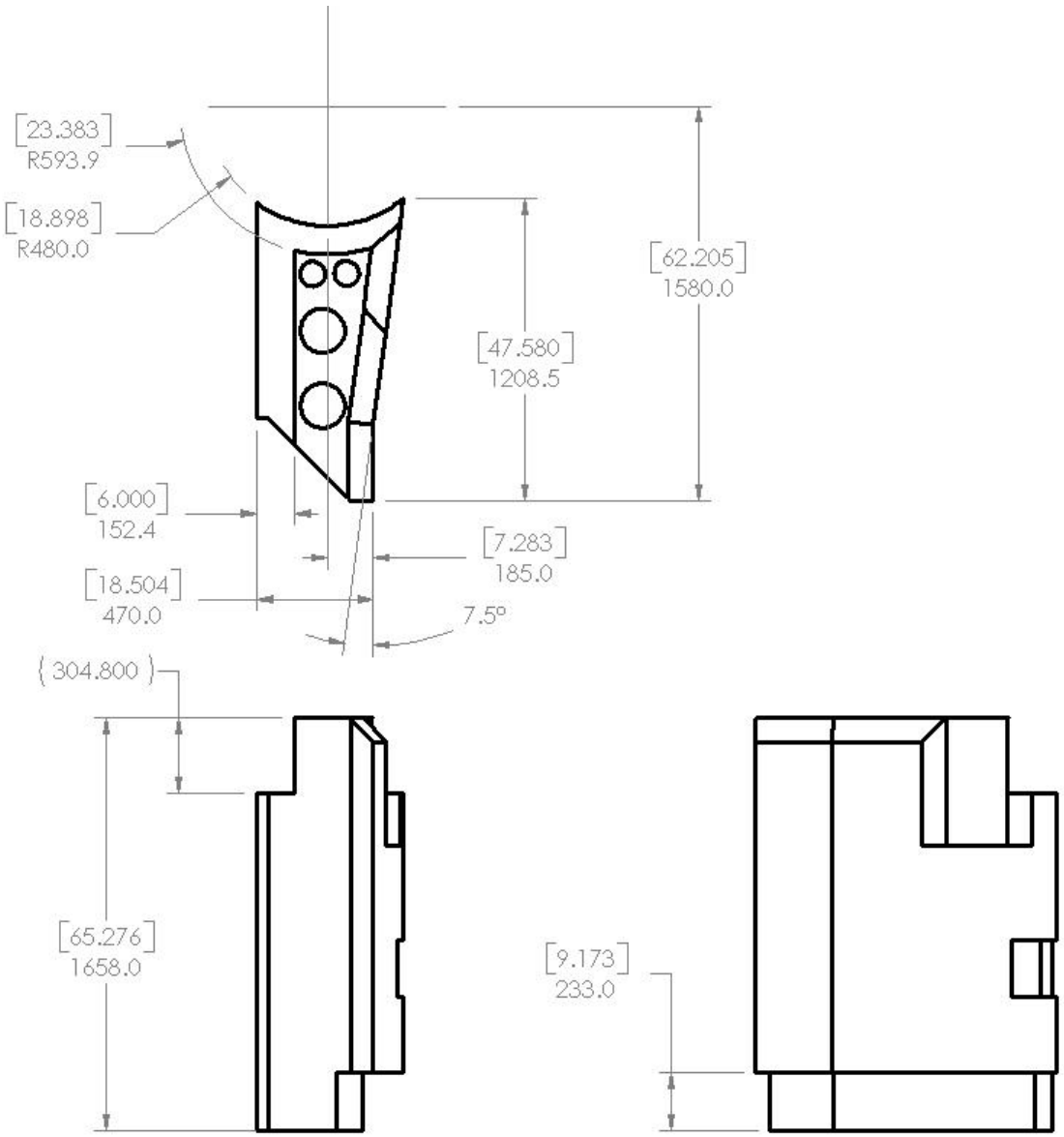

Figure 6 MBT North Shield

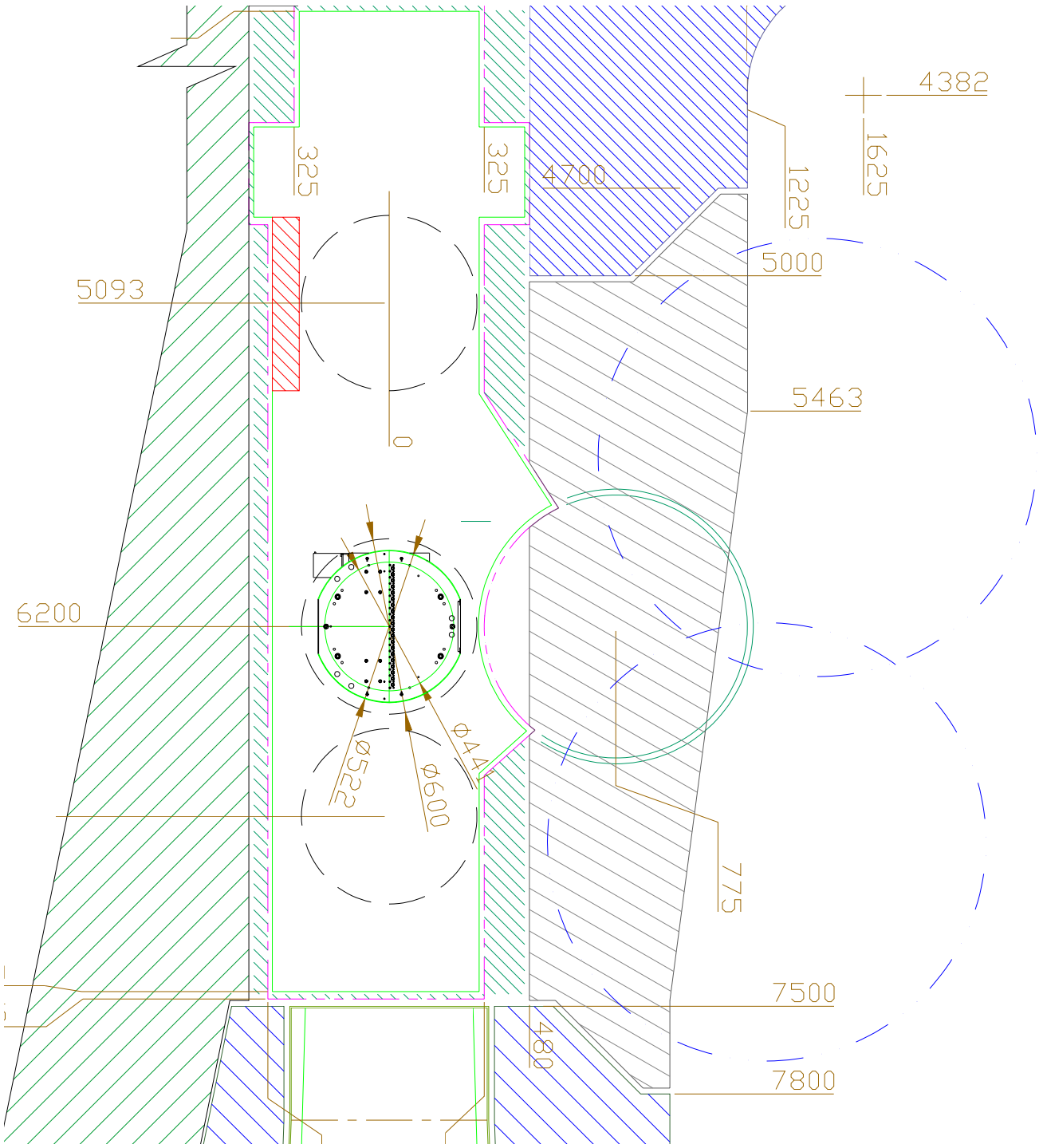

Figure 7 MACS General Layout

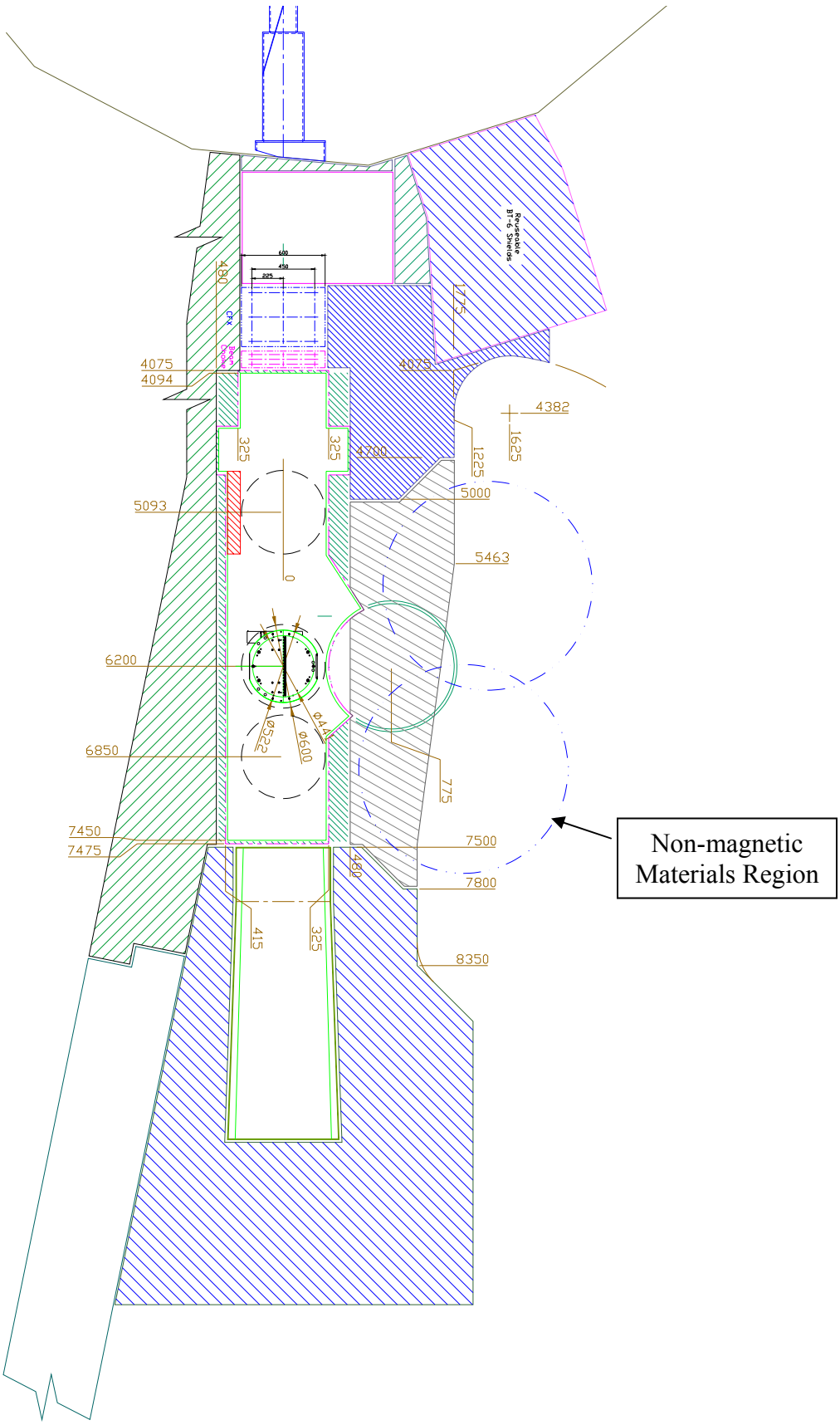

Figure 8 MACS General Layout.

Wedgmount® Precision Levelers VRC- / VRKC-Compact and KSC- KSKC-Compact, patented

Compact-elastic connection between machine foot and foundation

AirLoc precision levelers available in the following models:

- freestanding
- bolt-on
- bolt-through
- interlocking

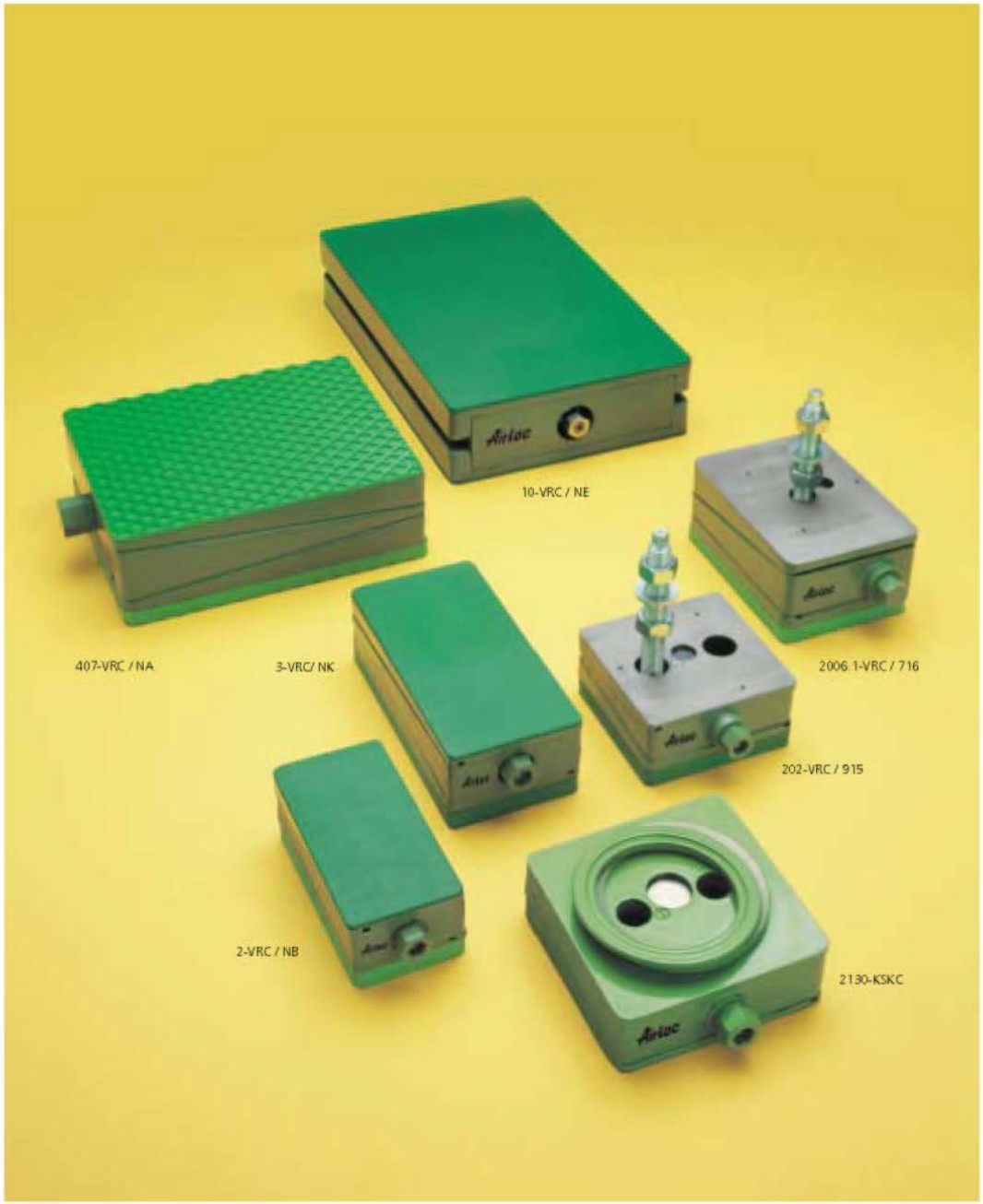

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Figure 9 Wedgmount Catalog

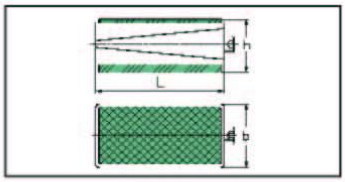
Wedgmount® Precision Levelers VRC-Compact patented
freestanding

AirLoc

VRC-Compact is the name of the ***AirLoc*** levelers with optimal characteristics. The outer and inner wedges always have an interlocking connection.

- Fine adjustment under full load to 1/100 mm
- Transverse stability due to pre-tensioned wedges
- Longitudinal stability due to concentric locking
- Space-saving, flat design made of cast iron
- Adjustable impact sound isolation of solid-borne sound
- Extensions to leveling screws upon request.

VRC freestanding



Applications:

NA For machine tools, plastic machines, printing machines, textile machines and production machines of all kinds. Latest design, with superior isolation, damping and non-skid properties.

NE For lathes, round and flat grinders, drills and milling machines, transfer lines and special machinery. Good level stability due to increased Shore hardness, high stability under load and non-skid protection.

NK High load, level stability, less isolation; for transfer lines, special machinery and machine tools.

NF For low frequency, soft installation requirements in floors, also as passive isolation from building vibrations, machine and laboratory instruments. Superior isolation with high coefficient of adhesion.

Pad type

AirLoc	Top	Bottom
NA	706	716
NE	903	903
NK	903	915
NF	903	B1

Other pad types upon request.
For detailed technical information and natural frequencies, please see pages 4 - 5.

Applications please see page 7.

Standard color: Reseda green / RAL 6011

Sample order:
Art. No. 1.30001.56 – 1-VRC / NA

Type VRC	Dimensions (mm)		Height h (mm) *AirLoc* Pad Artide No.				Leveling range (mm)	max. load per Wegmount daN			
	L	b	NA	NE	NK	NF		NA	NE	NK	NF
1-VRC	105	55	58 1.30001.56	44 1.30001.60	56 1.30001.65	54 1.30001.61	+ 2.5 – 7	1100	2500	2000	250
2-VRC	150	75	58 1.30002.56	44 1.30002.60	56 1.30002.65	54 1.30002.61	+ 5 – 5	2200	5000	4000	550
3-VRC	200	95	66 1.30003.56	52 1.30003.60	64 1.30003.65	62 1.30003.61	+ 6 – 6	3700	7500	6500	1000
4-VRC	200	200	66 1.30004.56	52 1.30004.60	64 1.30004.65	62 1.30004.61	+ 6 – 6	7800	14000	14000	2000
6-VRC	115	250	90 1.30006.56	76 1.30006.60	88 1.30006.65	86 1.30006.61	+ 6 – 10	5500	8000	8000	1400
7-VRC	175	230	90 1.30007.56	76 1.30007.60	88 1.30007.65	86 1.30007.61	+ 8 – 10	8000	10000	10000	2000
302-VRC	115	115	61 1.30302.56	47 1.30302.60	59 1.30302.65	56 1.30302.61	+ 4 – 5	2500	4500	4500	625
303-VRC	140	140	66 1.30303.56	52 1.30303.60	64 1.30303.65	61 1.30303.61	+ 6 – 6	3800	6500	6500	1000
306-VRC	115	115	88 1.30306.56	74 1.30306.60	86 1.30306.65	83 1.30306.61	+ 8 – 10	2500	4000	4000	625
406-VRC	115	250	74	60	72	70	+ 5.5 – 6	5500	8000	8000	1400
407-VRC	250	200	85 1.30407.56	71 1.30407.60	83 1.30407.65	81 1.30407.61	+ 11 – 10	10000	16000	16000	2500
410-VRC	300	250	101 1.30410.56	87 1.30410.60	99 1.30410.65	97 1.30410.61	+ 11 – 11	15000	25000	25000	3750

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Figure 10 Wedgmount Catalog Continued. See P/N 407-VRC-83 above.

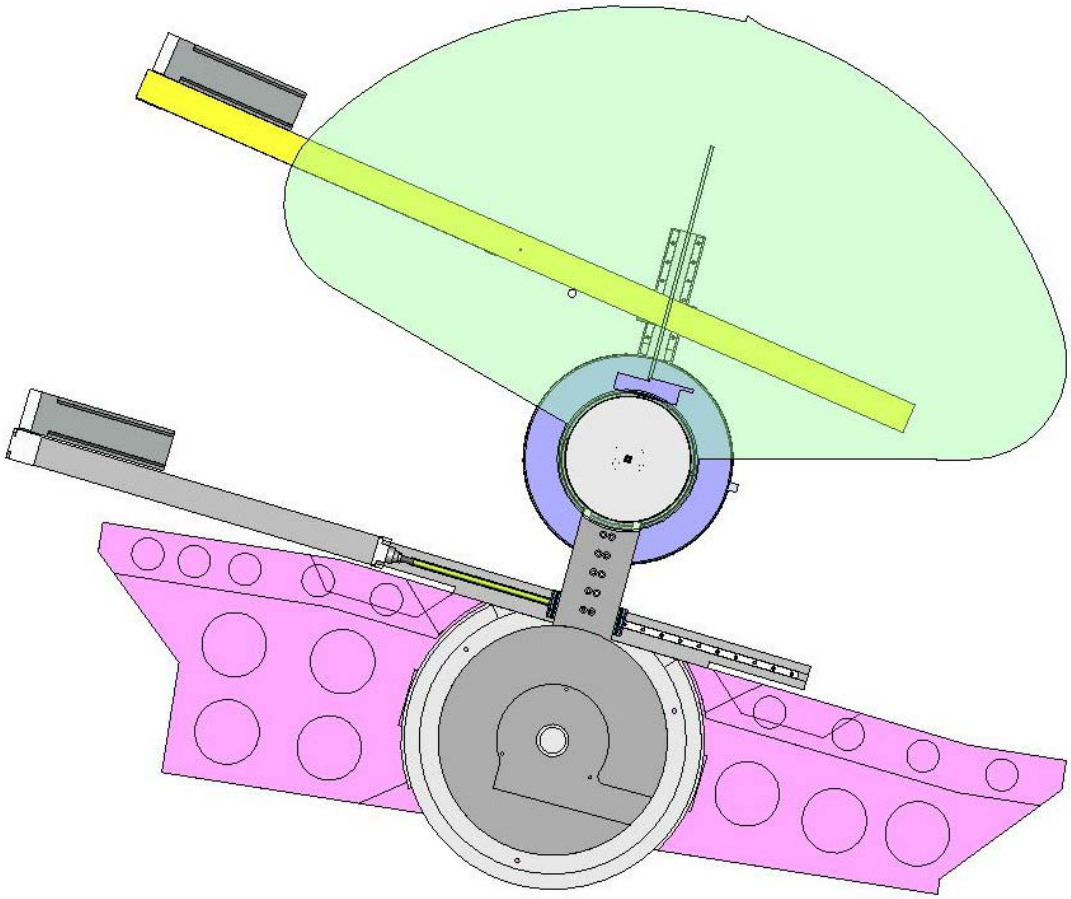

Figure 11 MBT Interfaces to the Sample Support and Analyzer Motion